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(54) Electric motor assembly having an auxiliary housing

(57) A miniature electric motor assembly includes an auxiliary housing or cover 25 for accommodating noise suppression components and/or modified terminal arrangements. The cover is secured to the end cap 22 of the motor by one or more securing pins 26. The pins extend through holes 35 in the cover and engage with holes 44 formed in the end cap 22. Preferably, the pins comprise a cross member 27 with two depending prongs 28, each prong having a number of barbs 30 formed at its distal end for engaging and locking with the holes 44 in the end cap 22.

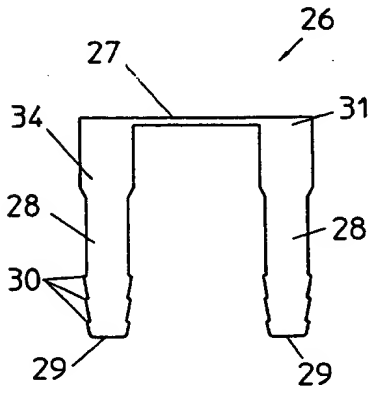

FIG. 2

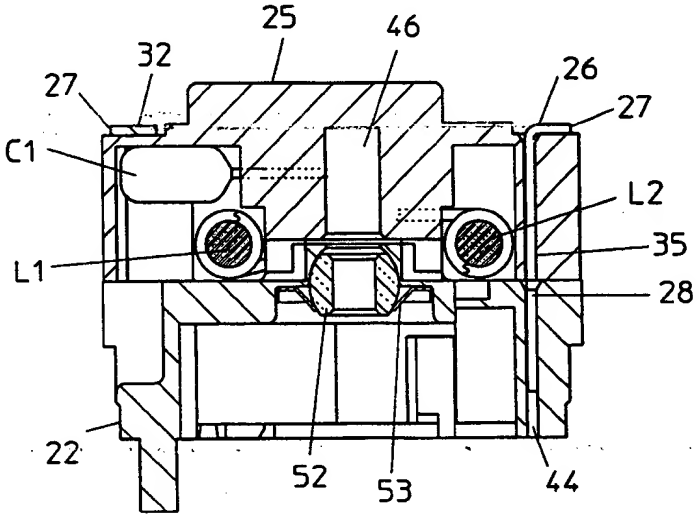

FIG. 9

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ELECTRIC MOTOR ASSEMBLY

Field of the Invention

This invention relates to an electric motor assembly and in particular, to an electric motor having an additional housing or cover for accommodating suppression elements, terminal adapters, etc. secured to the end cap of the motor and to a particular method of securing the cover.

Background Art

In prior art designs, suppression elements for miniature d.c. motors may include one or three capacitors, two chokes and/or a diode to suppress the electrical noise generated by the action of the commutator. However, for some applications, greater noise suppression is required than for others. This is achieved by varying the combination and/or rating of the selected components used when constructing the motor. These components are then built into the motor, generally mounted on the inside of the motor end cap. The components chosen do affect the cost of the motor. However, once the motor has been built, it is not feasible to disassemble the motor to change the noise suppression components as this disassembly would generally involve causing sufficient damage to the motor housing as the housing and end cap are usually crimped together to require the housing itself to be replaced. Even when separate housings have been fitted to the end cap to accommodate suppression elements, see for example GB 2222316, this separate housing is held to the end cap by the crimp used to secure the end cap to the housing. To replace the housing involves substantially rebuilding the motor.

However, there is a need for an arrangement where the motor can be completely built and tested and then fitted with a further separate housing enclosing suppression elements and/or terminal adapters as required for the intended application of each motor individually. Previously terminal adapter covers have used moulded tabs or fingers which co-operate with ridges or recesses on the housing or end cap to secure the cover in place. This type of coupling arrangement does not allow a cover to be fitted rigidly and securely to the motor sufficiently for the cover to be gripped by a robot for manipulation of the motor during automated assembly of the motor to an appliance, etc.

The present invention, provides a method of rigidly attaching an auxiliary housing or cover which may accommodate noise suppression elements and/or terminal arrangement adapters by using a fixing element such as a rigid pin or nail to secure the cover directly to the end cap. Accordingly, the present invention provides a miniature motor assembly comprising: a miniature motor having a housing accommodating a stator and a rotor and a plastics material end cap closing one end of the housing and supporting motor terminals, and an auxiliary housing for supporting supply connection terminals, wherein the auxiliary housing is rigidly connected to the miniature motor by fixing elements which pass through apertures in the auxiliary housing and mate with the end cap and the motor terminals are electrically connected to the supply connection terminals by circuitry within the auxiliary housing.

The use of fixing elements rigidly secures the auxiliary housing to the end cap. This allows standard motors to be produced and fully inspected and tested (and possibly stored) before fitting covers with the required external terminal arrangement and/or noise suppression components. Thus selection of terminal arrangements and noise suppression components can be made after the motor has been fully tested and allows motors to be assembled before final customer requirements are known.

The circuitry of the cover may include one or more noise suppression components. In this arrangement, the noise level of the motor can be modified post-assembly of the motor to satisfy new or changing customer requirements.

Preferably, the fixing elements are metal pins formed from sheet material, for example, the pins may be pressed from steel sheet as this is cost effective.

Preferably, each pin has two prongs extending from a cross member, each prong having one or more barbs formed at its distal end which extend into a recess formed in the end cap. At least one barb on each prong engages a wall of the respective recess to secure the auxiliary housing to the end cap. Thus, the cover is secured to the end cap by simply pressing the pins through the cover and into the recesses in the end cap. This is a process which is quick, easy, definite and can be readily automated. The cross member can also be used to support indicia related to the motor, contents of the cover, trade marks, etc. By bending the cross member to extend perpendicular to the prongs, a greater surface area for indicia can be provided.

Preferably, the prongs of the pins are wider at the root to form a snug fit within the apertures in the auxiliary housing. This allows the pins to be quickly and easily initially inserted into the apertures in the auxiliary housing with the play between the prongs and the auxiliary housing taken up by the wider portion at the root of the prongs as the pins are driven home to eliminate any unnecessary play between the pins and the auxiliary housing in the fully assembled state.

The prongs may have shoulders in the vicinity of their roots or attachment to the cross member and these shoulders bear against corresponding shoulders formed in the apertures through the auxiliary housing. In this way, the axial forces applied to the pins by attempted separation of the auxiliary housing from the end cap places the prongs of the pins in tension and eliminates any tendency to bow or bend the cross member. It also eliminates slack developing between the auxiliary housing and the end cap due to bowing or bending of the cross member.

Preferably, the motor terminals are male terminals which are slotted and arranged to straddle and grip a portion of the circuitry of the cover to make electrical contact therewith. This eliminates the need for soldering wires to the motor terminals or using special contact surfaces to connect with the motor terminals. By using part of the circuitry, i.e., the lead wires of noise suppression elements, for example, chokes, diodes or capacitors, or connecting wires between the motor terminals and the cover terminals where suppression elements are not used, a connection is eliminated reducing the resistance of the through connection and eliminating a potential source of failure.

Preferably, the circuitry of the auxiliary housing includes chokes for electrical noise suppression and the motor terminals have axially extending slots arranged to connect directly with lead wires from the chokes.

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings.

Brief Description of the Drawings

Figure 1 illustrates a motor assembly including an auxiliary housing, fitted to an end cap of a motor in accordance with the present invention;

Figure 2 is an elevational view of a fixing element in accordance with a preferred embodiment of the present invention;

Figure 3 is an end elevation of the element of Figure 2;

Figure 4 is a plan view of the element of Figure 2;

Figure 5 is an outside end view of the auxiliary housing of Figure 1;

Figure 6 is an inside end view of the auxiliary housing of Figure 5;

Figure 7 is an outside end view of the end cap of the motor assembly of Figure 1;

Figure 8 is an inside end view of the end cap of Figure 7;

Figure 9 is a sectional view of the end cap and auxiliary housing assembly with the end cap sectioned along Line 'A-A' of Figure 8 and the cover sectioned along Line 'B-B' of Figure 6;

Figure 10 is an exploded sectional view of the end cap and auxiliary housing assembly with the end cap sectioned along Line 'D-D' of Figure 7 and the cover sectioned along Line 'C-C' of Figure 5;

Figure 11 is a circuit diagram indicating noise suppression components and their connection within the auxiliary housing; and

Figures 12 to 15 illustrate alternative constructions for the fixing element to that illustrated in Figures 2 to 4.

Detailed Description of the Preferred Embodiments

In Figure 1, a motor 20 fitted with an auxiliary housing or cover 25 in accordance with the present invention is shown. The motor 20 is a miniature p.m.d.c. motor having a can-like housing 21 and a plastics material end cap 22 closing the open end of the housing. A motor shaft 23 is shown extending from the closed end of the housing for connection to an appliance or similar. The shaft supports a rotor and is journalled in bearings supported by the end cap and the housing. The motor may be of standard

construction as well known in the art and as its operation and construction is not particularly relevant to this invention, it will not be further described except as needed to explain the invention.

An auxiliary housing or cover 25 is fitted to the end cap 22 and appears as an extension of the motor. The cover is secured to the end cap by a pair of securing pins 26 (only one visible in Figure 1). One such securing pin is shown in Figures 2, 3 and 4. The pin 26 has a cross member in the form of a crossbar 27 from which two prongs 28 extend. The prongs at their distal end 29 have a number of barbs 30. The prongs are also wider in the region 31 adjacent the crossbar. The pin is pressed from steel sheet and the crossbar is bent 90° to provide a flat upper surface 32. This surface may be used to support any desired indicia such as information about the motor and/or trade marks, etc. In this form, the crossbar 27 can be used as the main contact surface between the pin 26 and the cover 25, to prevent axial separation of the cover 25 from the end cap 22.

Figure 5 shows an external end view of the cover 25 with the outline of the securing pins 26 shown in phantom to indicate the location of the pins in use. This view shows that the cover has four holes 35 for receiving the prongs of the two securing pins 26. There are also two apertures 36 for receiving male pins from a power supply connection plug. Female cover terminals are located within these apertures 36. Two further apertures 38 accommodate the male motor terminals. As the motor terminals enter the apertures from inside the cover 25 and do not extend all the way through these holes, the apertures may be blind, i.e., not visible from the outside of the cover. However, apertures which do extend through the cover as shown allow a visual check to confirm the presence of the motor terminals and the correct connection to the electrical circuitry of the cover. Likewise, apertures 39 and 40 which accommodate lead wires from the noise suppression components could be formed as blind recesses in the inside of the cover. However, as shown, the apertures extend through the cover. While the lead wires normally would not extend out of the cover, the apertures 39, 40 do allow a visual check to verify that the components are correctly installed. The apertures 36 for the cover terminals are formed in a boss or raised portion 41 of the cover. This raised portion may be shaped to mate with the power supply plug to provide additional holding support for the plug and terminals and/or it may be keyed or shape-locked to prevent reverse connection of the terminals. In the embodiment shown, one terminal aperture is formed wider than the other so that the terminals themselves being of corresponding widths, prevent insertion in the incorrect orientation.

Figure 6 shows the inside of the cover 25 with noise suppression components fitted. There are two chokes, L1, L2 and two capacitors C1, C2. The chokes are arranged to be connected between respective ones of the motor terminals and cover terminals while C1 is arranged to be connected across the motor terminals and C2 is arranged to be connected across the cover terminals in accordance with the circuit diagram of Figure 11. The components are accommodated in recesses formed in the cover. Female type cover terminals are riveted to respective terminal plates 42 which have slots 43 for making electrical contact with the lead wires of the components. The connection is a mechanical connection in which the slots straddle and grip the wires as the wires are pressed into the slots. This is easily automated, avoids soldering and is reliable. The slots 43 may be arranged to pierce any insulation covering the lead wires (if used). The motor terminals are also provided with slots 45 to make similar mechanical type electrical connections with the respective lead wires so that the electrical connection between the cover circuitry and the motor terminals is established simply by fitting the cover to the end cap of the motor. The lower terminal plate 42, as shown in Figure 6, has a portion cut away to reveal the slots 43 connecting with the lead wires.

Figures 7 and 8 are outside and inside views of the end cap of the motor. In Figure 7, the holes 44 for receiving the ends of the prongs of the securing pins can be seen. Also shown are the slots 45 in the end of each motor terminal 24. Three slots 45 are provided for symmetry to facilitate assembly, although two or even a single slot could be used. Apart from these, the end cap 22 is fairly standard.

In Figure 8, the holes 44 for the prongs can be seen. Although these are shown as through holes, they could be formed as blind holes. Also shown are brushes 50, brush arms 51, motor terminals 24, noise suppression capacitors C3, C4, a bearing 52 and a bearing retainer 53. The bearing 52, as more clearly shown in Figures 9 and 10, is a self-aligning sintered bushing. The capacitors C3, C4, are connected to respective motor terminals 24 and to the motor housing 21. The connection to the motor terminals is a mechanical connection similar to that previously described whereby first lead wires 54 are gripped by slots formed in the motor terminals as the motor terminals are pressed into the end cap. The second lead wires 55 are connected to the motor housing by being located in grooves 56 in the outer peripheral wall of the end cap so that as the end cap is fitted to the housing, the lead wires are squashed between the end cap and the housing making electrical contact therewith.

Figure 9 is a cross-sectional view of the cover 25 fitted to the end cap 22. The cover is sectioned along line B-B of Figure 6 while the end cap is sectioned along line A-A of Figure 8 but with the brushes, brush arms, motor terminals and capacitors omitted for clarity. Figure 9 shows the location of the chokes L1 and L2 and capacitor C1 within the cover in relation to the end cap as well as clearly showing a recess 46 for accommodating the motor shaft should it protrude from the end cap. However, the main purpose of this figure is to show the securing pins 26 connecting the cover 25 to the end cap 22. On the left side, the crossbar 27 of the pin can be seen pressing against the outer surface of the cover. On the right side, a prong 28 is shown extending through the aperture 35 in the cover and into one of the holes 44 in the end cap 22 where the barbs on the prong bite into the walls of the hole 44 to secure the pin in position, thereby securing the cover to the end cap.

Figure 10 is an exploded view of the cover and end cap assembly with various components omitted for clarity. Shown are the cover terminals 37, the motor terminals 24 and the end cap bearing 52 and its retainer 53. This figure illustrates the interrelationship between the cover 25 and the motor terminals 24. The cover has been sectioned along line C-C of Figure 5 and the end cap has been sectioned along line D-D of Figure 7.

The schematic wiring diagram of Figure 11 illustrates a typical noise suppression circuitry which could be used. Two capacitors C3, C4 are mounted to the inside of the end cap with one lead grounded (connected to the housing) and the other lead connected to a respective motor terminal 24. In the cover, a capacitor C1 is connected across the motor terminals while the other capacitor C2 is connected across the cover terminals 24. Chokes L1 and L2 interconnect the motor terminals to the cover terminals. However, in a basic embodiment, the cover may not contain any noise suppression components in which case, the circuitry of the cover would be two wires or equivalent current supplying members connecting the motor terminals to the cover terminals.

Although the securing pins have been described with the main contact between the cover 25 and the pins 26 being the crossbar 27, the pins could be single pronged and/or the prongs 28 could be formed with shoulders 47 which bear against corresponding shoulders or ledges formed on the cover, preferably around the holes for the securing pins, to secure the cover to the end cap. The shoulders may be formed on the edge of the holes. Examples of such modifications are shown in Figures 12 to 15. Shoulders 33

are shown in Figures 12, 13 and 14. Figures 14 and 15 illustrate single pronged securing pins. The pin 26 of Figure 15 is shown in end view and is similar to the pin of Figure 14 except that a portion of the upper part of the pin is bent perpendicular to the prong to provide a flat upper surface 32 for indicia, etc., similar to the pin of Figure 12.

As mentioned previously, the pins may be slightly wider at the root 31 compared to the distal end 29 so that as the pins enter the through holes in the cover, there is some play allowing easier insertion. This play is taken up by the wider portion of the pin as the pins are fully inserted into the cover and end cap. Wider portions 34 are shown in Figures 2, 13 and 14.

CLAIMS

1. A miniature motor assembly comprising: a miniature motor having a housing accommodating a stator and a rotor and a plastics material end cap closing one end of the housing and supporting motor terminals, and an auxiliary housing for supporting supply connection terminals, wherein the auxiliary housing is rigidly connected to the miniature motor by fixing elements which pass through apertures in the auxiliary housing and mate with the end cap and the motor terminals are electrically connected to the supply connection terminals by circuitry within the auxiliary housing.

2. An assembly as defined in Claim 1, wherein the fixing elements are metal pins.

3. An assembly as claimed in Claim 2, wherein the pins are formed from sheet material.

4. An assembly as defined in Claim 2 or Claim 3, wherein the pins are substantially U-shaped with two extending prongs joined at one end by a cross member.

5. An assembly as defined in Claim 4, wherein each prong is generally rectangular in cross-section and has barbs formed along at least one of its elongate edges, the barbs being arranged to engage recesses formed in the end cap to resist separation.

6. An assembly as defined in Claim 4 or Claim 5, when dependent on Claim

2, wherein the cross member has at least a portion extending perpendicularly to a plane containing the two prongs.

7. An assembly as defined in any one of Claims 4 - 6, wherein the prongs of the pins are wider at the root to form a snug fit within the aperture in the auxiliary housing.

8. An assembly as defined in any one of Claims 2 - 7, wherein the pins have shoulders which bear against corresponding shoulders formed in the apertures through the auxiliary housing.

9. An assembly as defined in any one of the preceding claims, wherein the circuitry of the auxiliary housing includes chokes for electrical noise suppression and the motor terminals have axially extending slots arranged to connect directly with lead wires from the chokes.

10. A miniature motor assembly substantially as hereinbefore described with reference to the accompanying drawings.

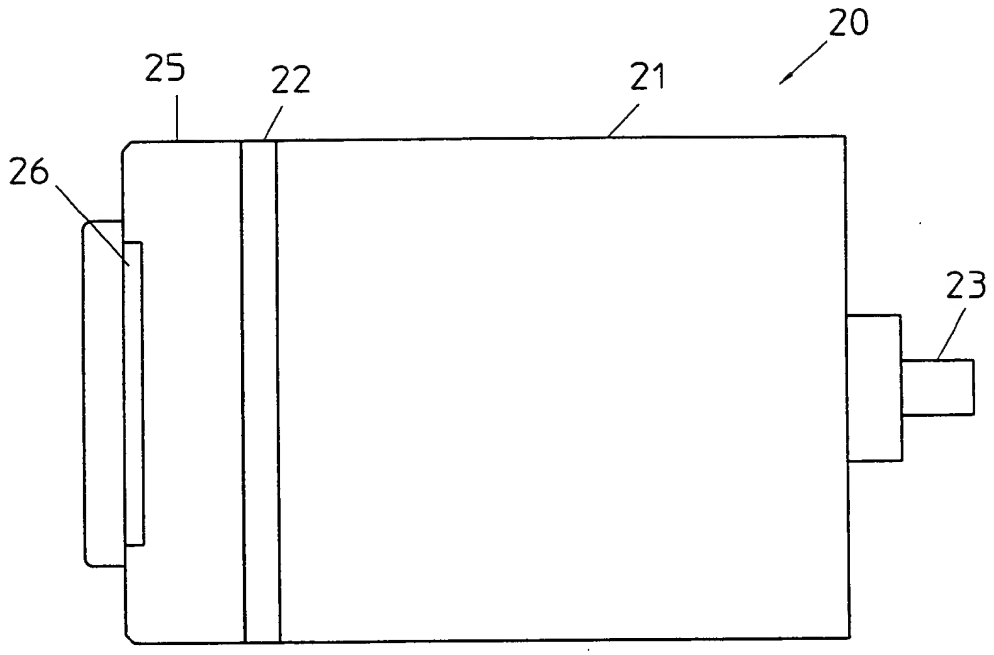


FIG. 1

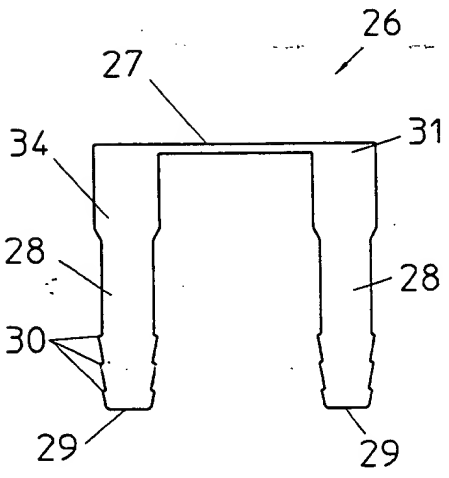


FIG. 2

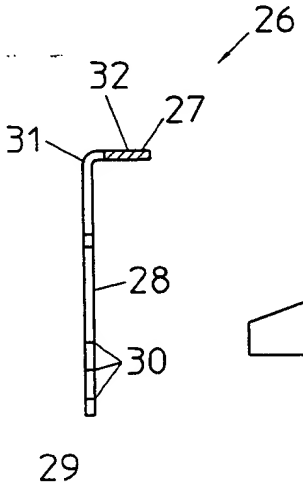


FIG. 3

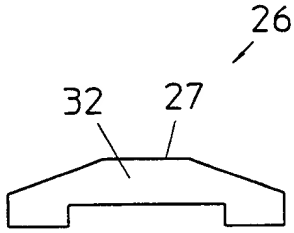
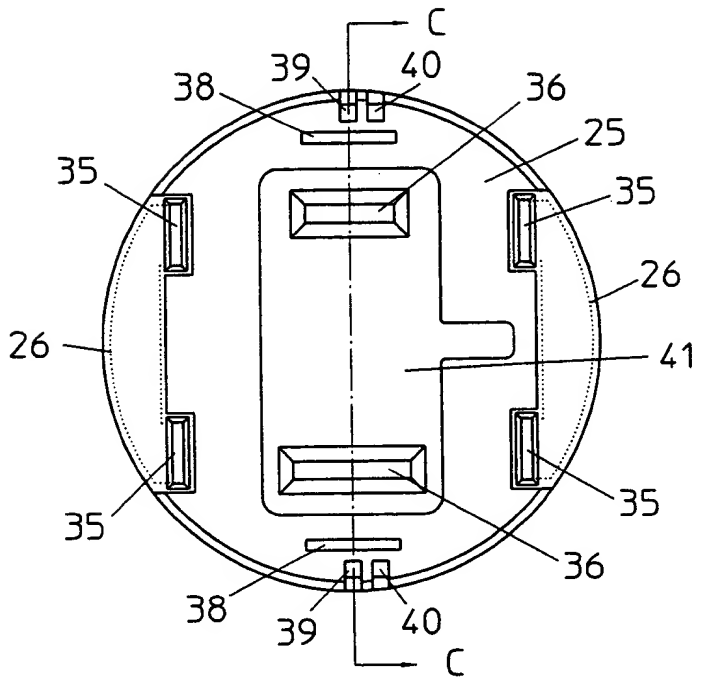


FIG. 4


C
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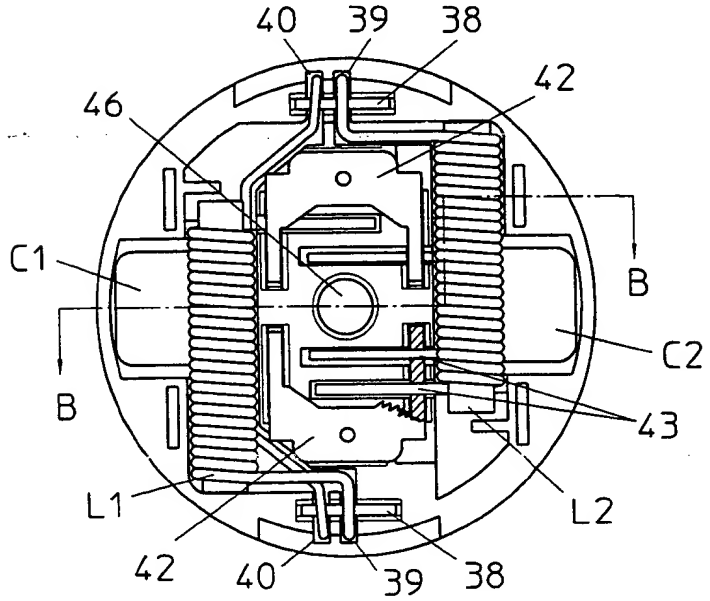
C

FIG. 5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C1
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L1
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FIG. 6

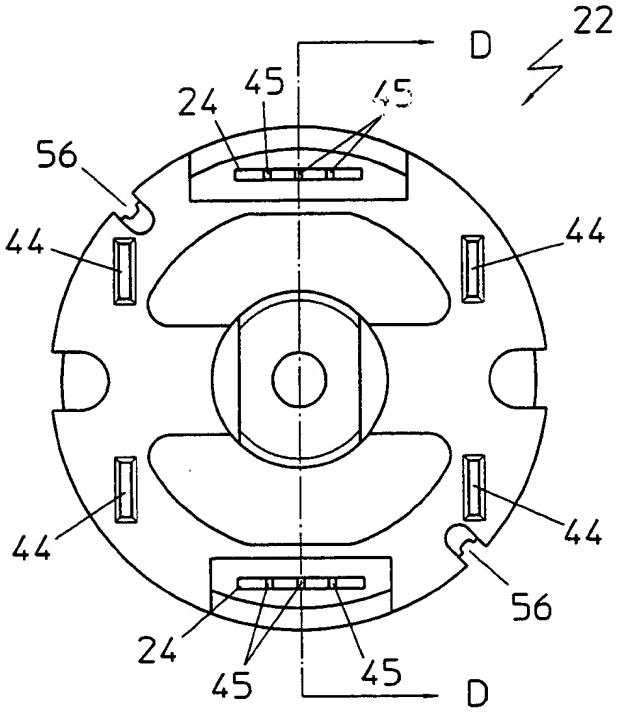
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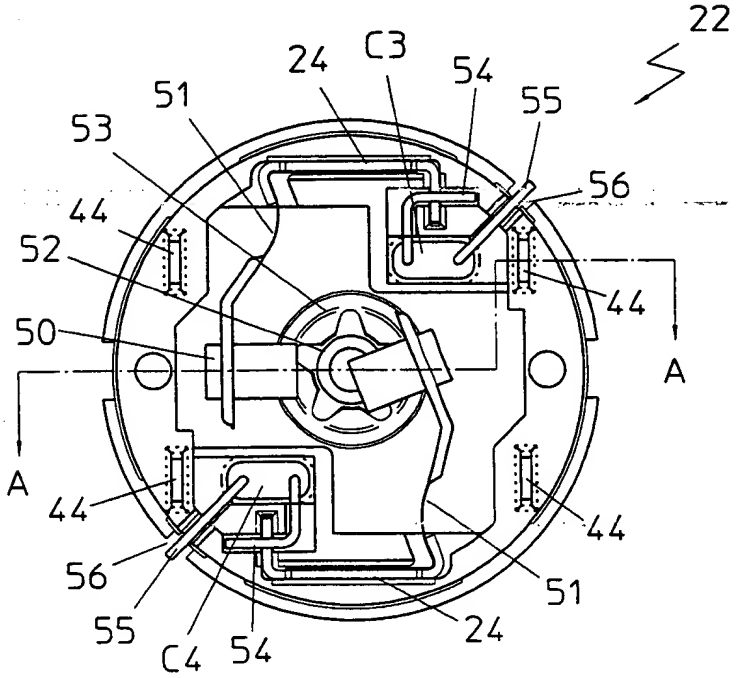
FIG. 7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C3
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C4
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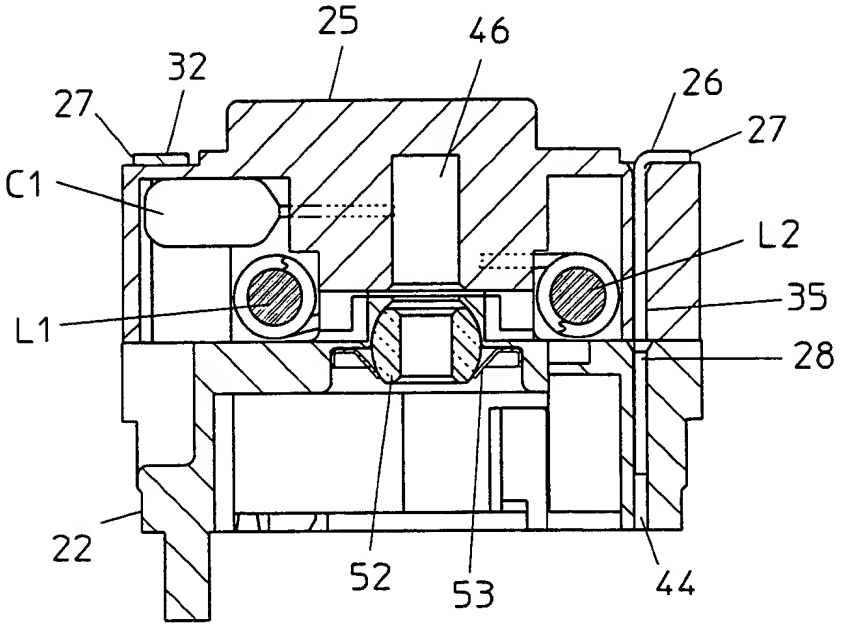
FIG. 8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L1
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FIG. 9

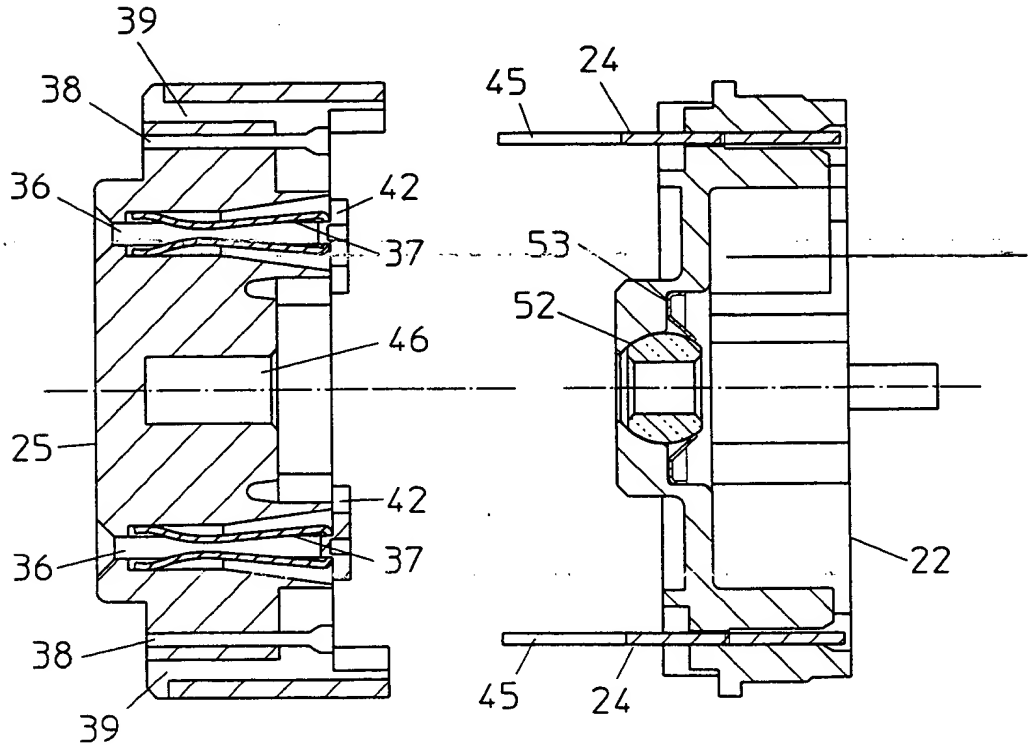
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FIG. 10

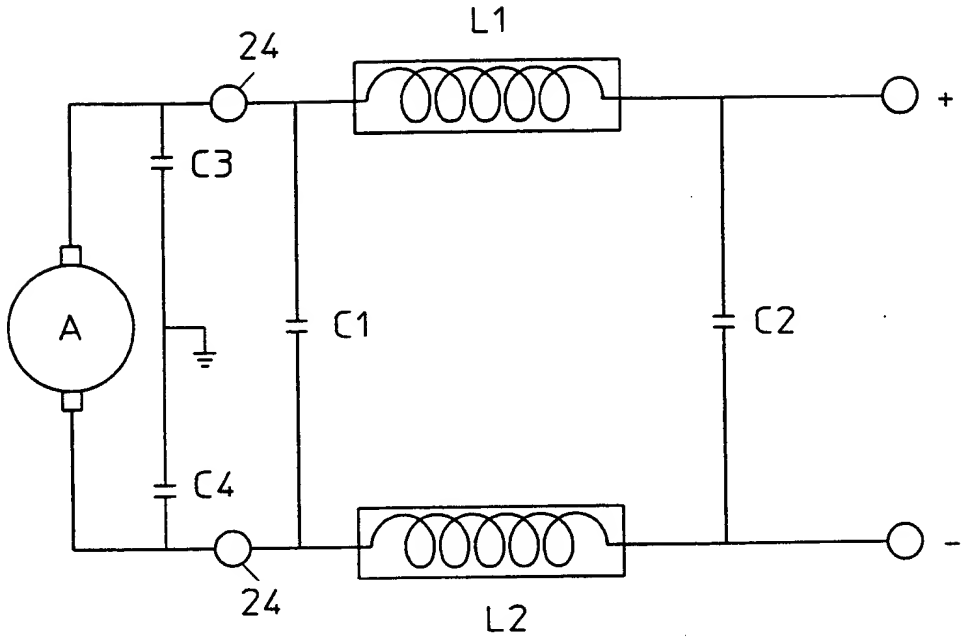

FIG. 11

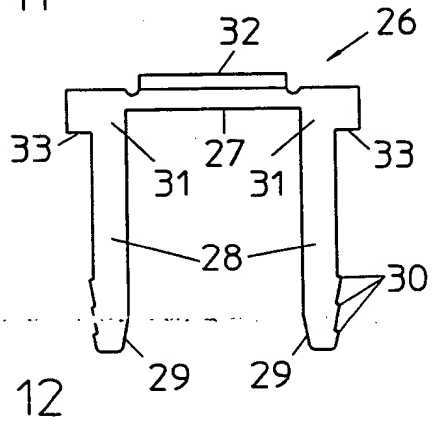

FIG. 12

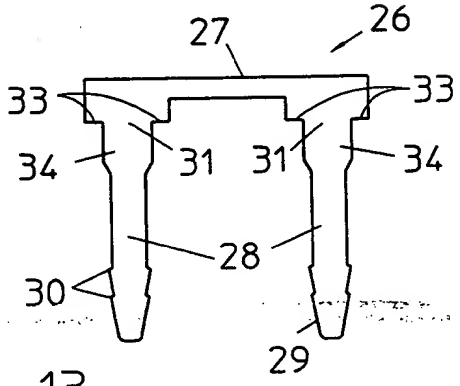

FIG. 13

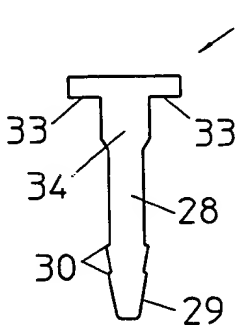

FIG. 14

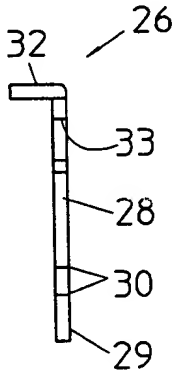

FIG. 15

The Patent Office

Application No: GB 9504283.4 **Examiner:** Mr J Cockitt
Claims searched: 1-10 **Date of search:** 3 May 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H2A [AKB1, AKT1, AKT2, AKT3, AKT4, AKT5]

Int Cl (Ed.6): H02K [05/22]

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2232011A	JOHNSON	
A	WO93/00513A1	TEVES	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.